Engaging with Complexity – Human Behaviour Representation

Lawrence Dack, Jim Sanderson, Jessica Allen, Nicola Schranz, Patrick Beautement

INTRODUCTION

Niteworks is a partnership between Ministry of Defence (MOD) and the UK defence industry. Its mission is to serve defence as the definitive partnership providing decision support to enhance current and future military capability.

This paper describes aspects of one Niteworks project, entitled Decision Support in Complex Environments (DSCE). Complex environments – a term which includes the concepts of Irregular and Hybrid Warfare - result in complex outcomes to decisions, creating a requirement to support planners and decision-makers. The DSCE project seeks to derive and develop capability requirements that, if met, will enhance understanding of increasingly complex and dynamic environments. It has three main outputs:

- A Complexity think-piece which sheds light on the 'landscape' of complex environments;
- A Capability review providing pan-Defence Line of Development (DLoD) recommendations of improvements to capability;
- A Hybrid Conflict Context Model (HCCM) which provides a high-level visualisation of possible outcomes, generating insights and indicators for real-world situations.

Hybrid conflict will bring new challenges to the military decision maker as traditional methods to manage complexity in the battlespace come under pressure from: 'blurring' of command and control lines (UK National/Coalition/Other national); the number of actors involved in Stabilisation; the consent of the local population; the nature of the insurgent (within the spectrum of the society); and the transition of responsibilities back to the Host Nation government.

Each aspect of a complex environment could be taken as a single component and modelled to help provide some improved understanding. In reality the components overlap and interlock, therefore a holistic solution rather than single component analysis is required. It is the relationships and behaviours that link the components that are most critical to understand and exploit.

The DSCE project has used System Dynamics to create a simulation model that explores relationships and behaviours in a complex environment. It is flexible, agile, and light-weight in use – meaning that minimal war-fighter interaction is required. The model is focused on the relationships and behaviours between: the actors in an operational environment, the consent of local population groupings, and the physical environment, in order to provide a greater level of insight and understanding to decision-makers. It has recently undergone a series of validation reviews that have deemed it fit for Training and Experimentation activities within the British Army; there remains an aspiration to mature it into a model suitable for support to Operations.

RELEVANCE TO SYMPOSIUM

The relevance of this work to the symposium is in the approach taken to use rapidly developed and deployed models to improve military understanding of complex environments and provide a mechanism to

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
OCT 2009	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Engaging with Complexity Human Behaviour Representation	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **NATO**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
See also ADA562563. RTO-MP-MSG-069 Current Uses of M&S Covering Support to Operations, Human Behaviour Representation, Irregular Warfare, Defence against Terrorism and Coalition Tactical Force Integration (Utilisation actuelle M&S couvrant le soutien aux operations, la representation du comportement humain, la guerre asymetrique, la defense contre le terrorisme et l'integration d'une force tactique de coalition). Proceedings of the NATO RTO Modelling and Simulation Group Symposium held in Brussels, Belgium on 15 and 16 October 2009., The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**SAR**	**8**	

support systemic capability development. The model reaches across the topics of Human Behaviour Representation, Support to Operations and Irregular Warfare.

RATIONALE

Complex environments are often heavily interconnected, in ways that bring about counter-intuitive results through feedback loops. Some are adaptive; they change in response to events.

Military commanders work with complex situations all the time. Some even deliberately bring them about to achieve their ends. So, in principle, some commanders at least 'get' complexity - but others may not. Certainly past studies using computer simulations[1] have shown that even experienced managers and leaders find it difficult to apply strategies which provide long-term success in complex situations; there is a tendency to focus too much on short-term gain and ignore lagged, but eventually significant, aspects of the problem until it is too late.

The selection criteria for a tool that allows representation of the dynamics of a complex situation are demanding. 'Classic' System Dynamics addresses some aspects – it provides a good way to visualise the effects of feedback loops at a high level, but is not adaptive. A related tool, Simile, augments Systems Dynamics with some Object-Oriented (OO) concepts that allow some adaptive behaviour to be expressed.

The DSCE project has used Simile to construct the HCCM model as a tool to illustrate possible effects of decisions. The model is, by design, very much the servant of its user; its purpose is to illustrate possible futures and so provide the decision maker with the ability to 'ask good questions'. As such, it can be exploited in a variety of contexts. The DSCE project was directed to consider three:

- Training - in which the mindset of a decision-maker can be acclimatised to complex situations;
- Experimentation – in which new approaches to complex situations can be developed;
- Operations – in which alerts and indicators can be derived to support decisions concerning a particular complex situation.

METHODS AND RESULTS

The HCCM brings together military judgment and human sciences to explore, understand and provide insight to questions by exploring the type and nature of relationships between actors (physical forces), operational environment and human behaviour.

The model has three main components; Actors (clustered into Coalitions), Regions, and Groups. The value of the model lies in the manner in which Coalition Interventions in a Region have significant Consequences for a population Group, and Coalition Influences on a Group affect the Permissiveness of a Region and thus impact the effectiveness of Interventions there.

[1] "The Logic of Failure", Dietrich Dorner (1982, tr. 1996) ISBN0-201-47948-6

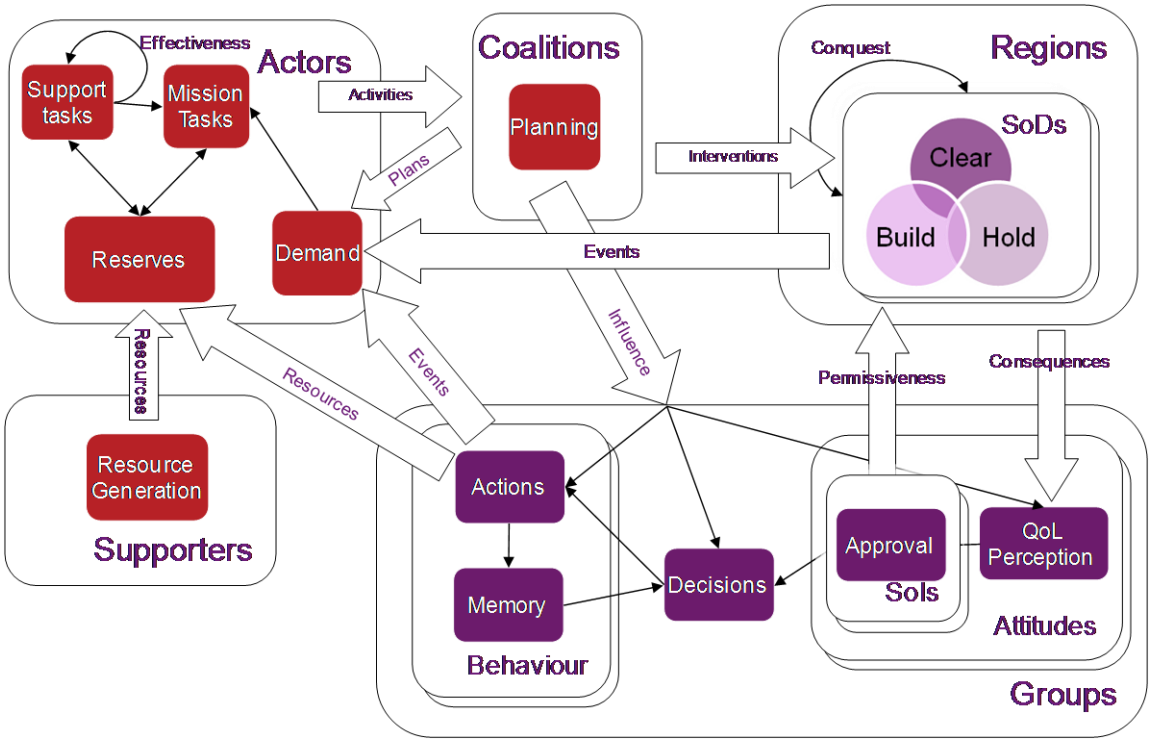

Figure 1: The main features and interactions of the HCCM

The red portions of Figure 1 above describe how Actors receive Resources from all sources – Supporters, internal actions, and Groups, and transform them into Activities which contribute to Coalition Interventions (directed at Regions) and Influences (directed at population Groups).

Interventions either change the state of territory within a Region (between Clear, Hold, and Build) or change 'ownership' of territory from one Coalition to another. They also have Consequences on the Groups living in those territories.

A Group summarizes the behaviour of collections of people whose attitudes and behaviours are likely to be coherent. The divide could be (for example) along political, ethnic, or religious boundaries. The main features of human behaviour represented in the model are shown in Figure 2 below.

Every Coalition Activity carries a message and has an impact on the population in the region in which it takes place. For some Interventions this may be the main point of the activity; for others (Combat) it may be a by-product. Each group is assumed to evaluate these impacts in terms of its own Quality of Life (QoL in Fig 1). The contentedness of a group is assumed to relate to the difference between current state and expectations.

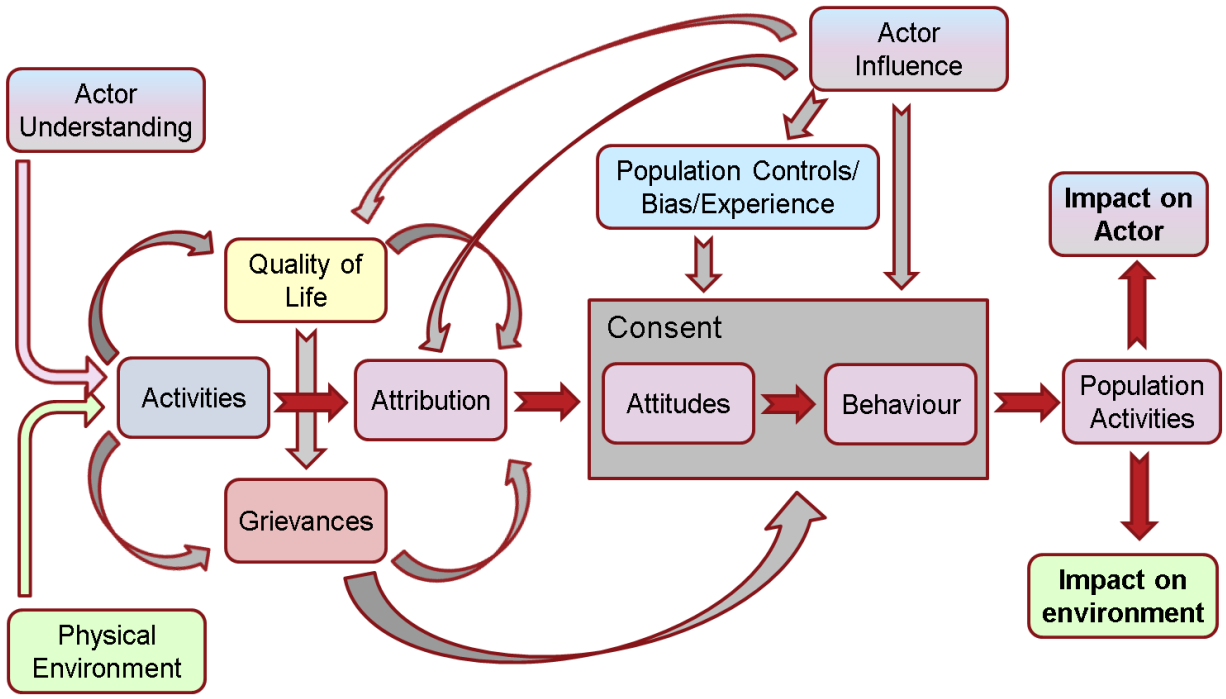

Figure 2: Human behaviour representation within the HCCM

Groups model Attitude – what individuals within a group think – and Behaviour – how they act. Attitudes are measured in terms of the Consent each Group awards to a given Coalition – so for example 10% of Group A might be Loyal to Coalition X, 50% Agnostic to X, and 40% Antagonistic to X. Attitudes are derived from a Group's Quality of Life, but modified by the attribution of beneficial or harmful activities (so it is possible that the credit for the good deeds of one Coalition might be given to another).

The Behaviour of a Group towards a Coalition is related to its Attitude towards that Coalition, but the two are not in lockstep. Influence activities by the different Coalitions – either Persuasion or Coercion - may cause a Group to behave in ways that are at odds with its attitudes.

A Group has certain resources available to it; it may choose to gift some or all of these to a Coalition. The offering of a gift involves a cost. The exploitation of that gift brings a benefit to the donor – but the Coalition may not exploit the gift, so each Group is taking on a certain cost in the uncertain hope of benefit. The experience of each Group impacts future decisions – a costly gift spurned makes a Group less likely to offer similar gifts in future. In a more general way, the attitude of a Group also impacts the permissiveness experienced by the Coalition governing the Region a Group lives in.

USING THE MODEL

Figure 3 shows an overview of the model usage cycle. The model itself exists in two parts (Simile and a Spreadsheet). Within Simile there is the System Dynamics representation of the model which can be explored by the user. The model contains a number of parameters which must be set. Direct entry of these quantities requires more knowledge of the model's behaviour than can be expected of a non-expert user, so a spreadsheet has been created which insulates the user from the model internals; instead it

prompts for data that relates to the British Army's '7 Questions' estimate process, from which it calculates the parameters the model requires.

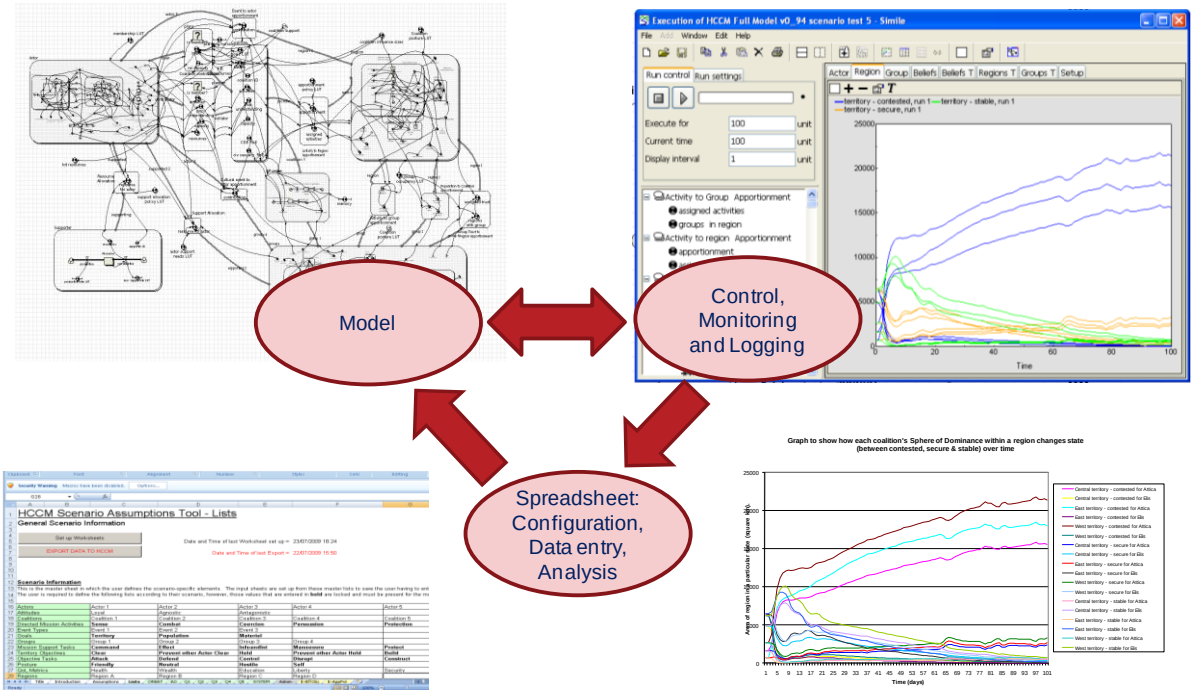

Figure 3: Overview of model use

When the model is executed, a monitoring and control panel is also displayed. This allows control of the simulation and variation of model input parameters, and interactive display of any model element. Model elements can be logged to file, and these files opened for further post-run analysis in Excel.

EXPLOITATION

At inception the DSCE project was directed to consider model exploitation in three related areas Training, Experimentation, and Operations. As Figure 4 shows, these concepts are related: Experimentation develops the techniques, Training teaches practitioners to map techniques to appropriate situations, and Operations applies those techniques to real-world issues.

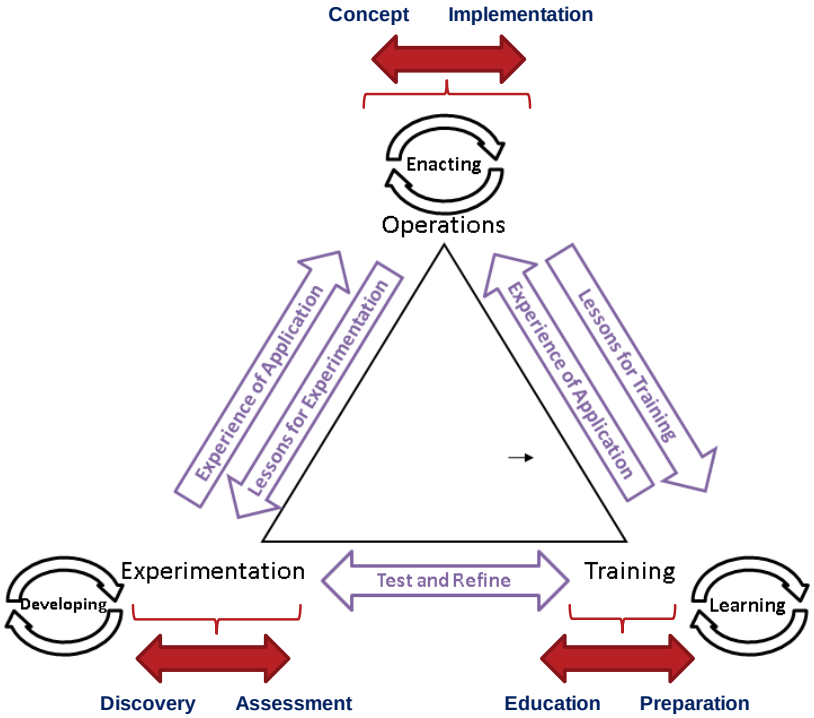

Figure 4: The learning relationships between Experimentation, Training, and Operations

In its current state of maturity the HCCM has obtained validation for use in Experimentation and Training, but not Operations (the model, and more importantly its calibration data, requires further testing to demonstrate confidence in the model outputs). This testing falls within the scope of the next phase of HCCM development; we can, however postulate likely exploitation routes.

Experimentation. Experimentation is undertaken to provide evidence for the worth of new ideas and techniques. Its aims can be qualitative discovery and exploration, or quantitative assessment and/or prediction.

Experimentation using this model will likely seek to assess novel ideas in challenging environments; perhaps exploring new doctrine against emergent threats. It is unlikely that extant historical data will be comprehensive enough to demonstrate the validity of the entire model configuration. This suggests that the model is more appropriately used for the exploration of a complex space (high coverage, lower burden of proof) rather than selection of a solution option (low coverage, higher burden of proof).

Training. An SD model can assist educative training in several ways:

- Didactically – providing a dynamic visual aid which illustrates points that the instructor wishes to make.
- Immersively – creating a virtual situation posing challenges to which a trainee must respond.

Neither of these approaches requires factual accuracy (arguably quite the reverse), nor high fidelity (it would be quite in order to strip a situation of distracting irrelevancies) but they do require a good representation of effect. Ultimately the model should do 'interesting' things that have relevance to the real world, but it is not necessary that the model should represent the real world.

CONCLUSIONS

Military simulation models have tended to provide detailed representations of quantitative and complex interactions. They are typically produced to large scale, over a long period of time and to a high degree of validation, as the basis from which balance of investment decisions may be made.

The HCCM is ideally placed to explore questions where complex feedback mechanisms may initially cloud the effects of the activities that are undertaken and investigate where a re-balancing of effort may be of value to achieving the goals of the scenario. We believe the model can support investigations in to:

- Exploring the balance between kinetic and non-kinetic strategies.
- Exploring the impact of a dynamic threat e.g. the change that out of area fighters might bring to a localised insurgency.
- Exploring the balance between persuasive and coercive influence strategies.
- Exploring the tensions between gaining control of territory and gaining the peoples' allegiance within territory.
- Exploring the relationship between quick impact projects ("do good things") and supporting the development of Host Nation Capability.

Therefore Niteworks anticipates that the military could derive significant benefit from developing simulation models on the more agile end of the scale of use (such as HCCM). This approach has the advantage of being, direct, short-term, small-scale and allows the practitioners to derive timely insights.